ABSTRACT

A method of semiconductor eutectic alloy metal (SEAM) technology for integration of heterogeneous materials and fabrication of compliant composite substrates takes advantage of eutectic properties of alloys. Sub1 and Sub2 are used to represent the two heterogeneous materials to be bonded or composed into a compliant composite substrate. For the purpose of fabricating compliant composite substrate, the first substrate material (Sub1) combines with the second substrate material (Sub2) to form a composite substrate that controls the stress in the epitaxial layers during cooling. The second substrate material (Sub2) controls the stress in the epitaxial layer grown thereon so that it is compressive during annealing. A joint metal (JM) with a melting point of T_m is chosen to offer variable joint stiffness at different temperatures. JM and Sub1 form a first eutectic alloy at a first eutectic temperature T_{eu1} while JM and Sub2 form a second eutectic alloy at a second eutectic temperature T_{eu2}. T_{m1} and T_{m2} are the melting points of Sub1 and Sub2, respectively. The following condition should be met: $T_{m1}, T_{m2} > T_m > T_{eu1}, T_{eu2}$. After cleaning of Sub1 and Sub2, JM is deposited on the bonding sides of Sub1 and Sub2. After preliminary bonding by applying force to press the bonding surfaces together at room temperature, high temperature bonding is subsequently performed, during which the temperature is ramped up to a temperature equal to or higher than T_m. During cooling, JM solidifies first, after which two eutectic alloys solidify.